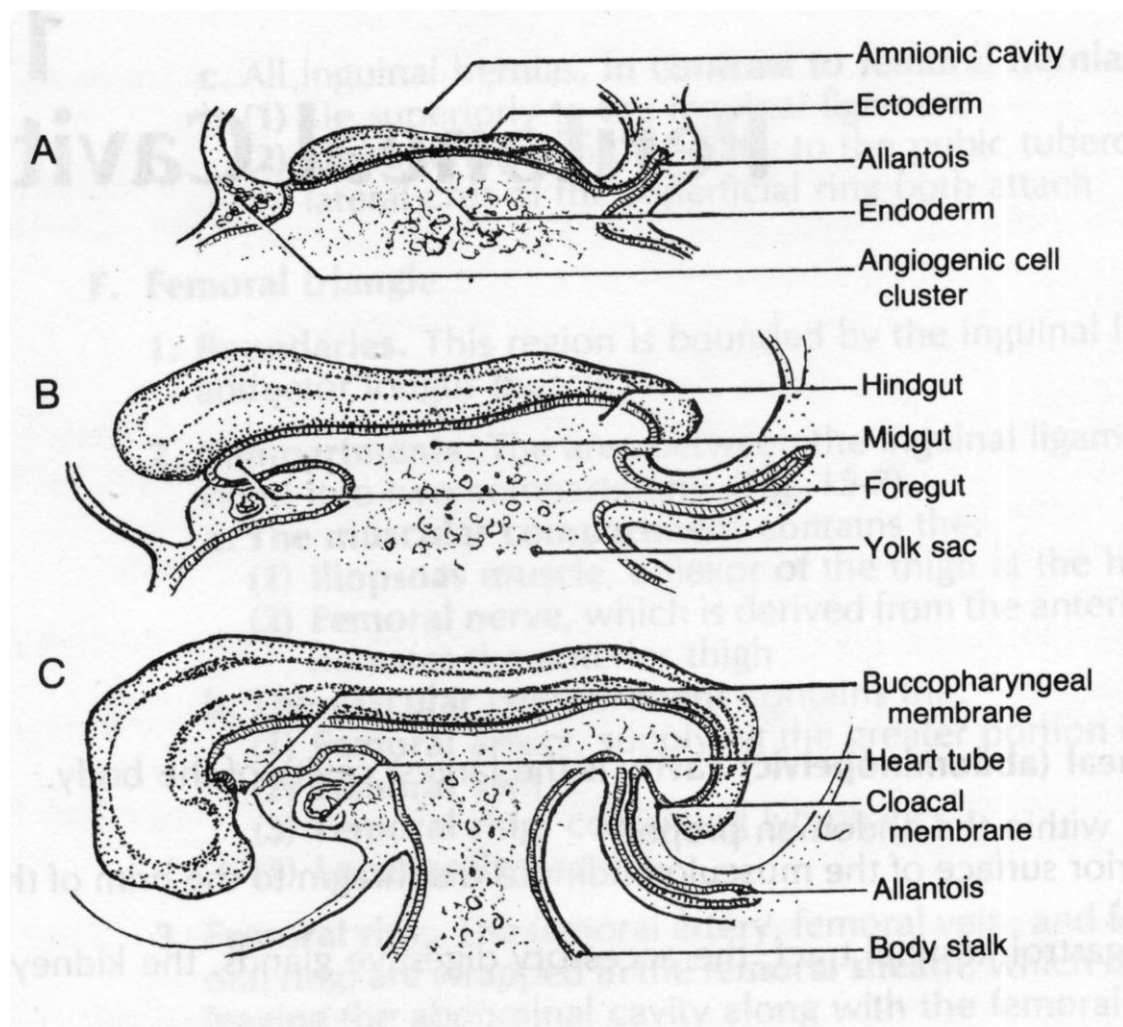


# **THE GI TRACT**

**Yiannis P Panayiotopoulos, MD, PhD**



- *Early development of the gastrointestinal tract*

**serosa** [not in all parts]

**Innervation:** The **nerve plexus of Meissner** lies in the submucosa while the **Auerbach plexus** lies between the circular and longitudinal muscle layers.

- OESOPHAGUS:** The mucosa is **squamous**. Its lower part may have columnar epithelium around the cardioesophageal junction. The muscle coat has an **inner circular** and an **outer longitudinal** area. **Lacks serosa**. Only 3-5cm of the intra-abdominal oesophagus are covered anteriorly by peritoneum.

- b. **Stomach:** The mucosa is cylindric [columnar]. Bears crypt-like glands, projecting down to the muscularis mucosa. The body has **oxyntic [parietal] cells** [secreting acid] **goblet cells** [secreting mucin] and **chief [zymogen] cells** secreting [pepsin and intrinsic factor]. The muscle coating has an extra **innermost layer of oblique fibers**.
- c. **Duodenum:** Cylindric mucosa with crypts extending through the submucosa forming the **Brunner's glands**.
- d. **Small intestine:** Cylindric mucosa having a lot of **villous processes** to increase its absorptive surface
- e. **Large intestine:** Cylindric mucosa with lots of mucous secreting **goblet cells**. The longitudinal muscle layer is incomplete [with the exception of rectum] forming the **taeniae coli**.

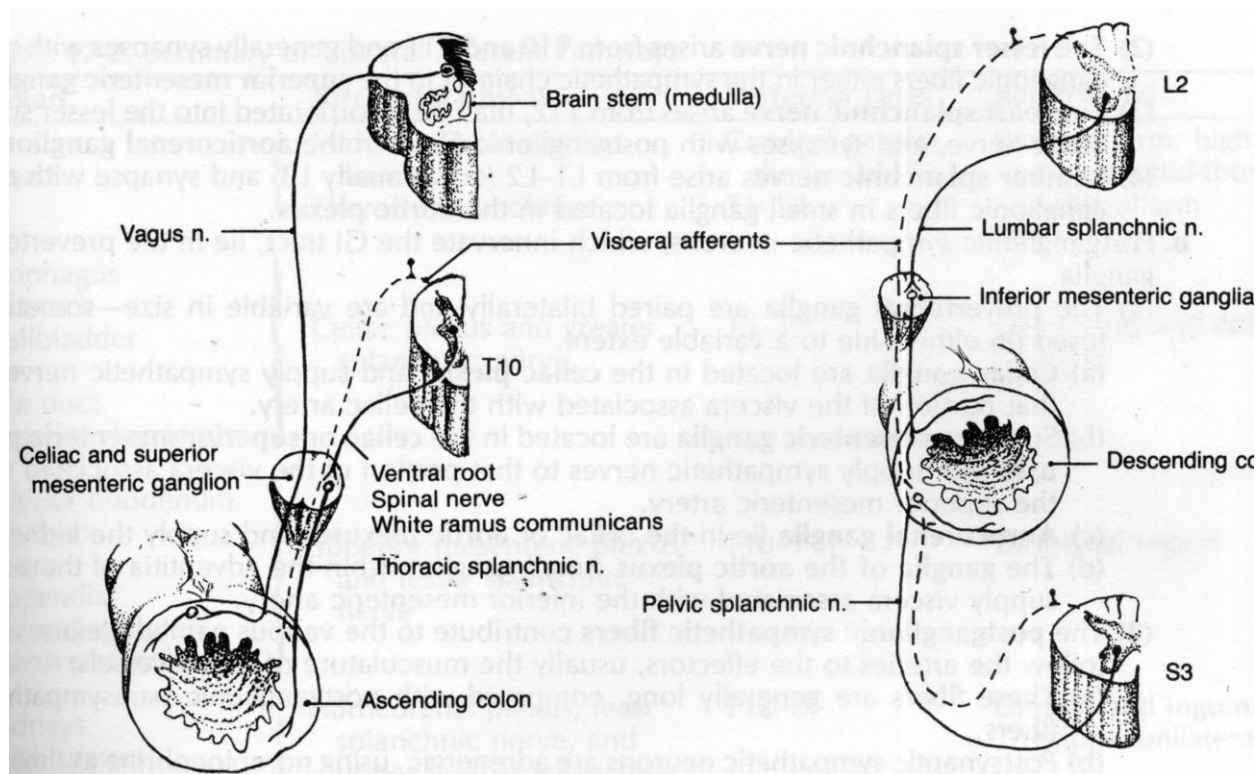
### ARTERIAL SUPPLY

- **Foregut:** **Coeliac axis** and its branches [branch of the aorta at T12 level]
- **Midgut:** **Superior mesenteric artery** [L1, aorta]
  - **inferior pancreaticoduodenal** [the 1<sup>st</sup> branch, bifurcating in anterior and posterior branches which curve around the head of the pancreas]
  - 12-15 **jejunal and ileal** branches arising to the left
  - **middle colic** artery
  - **right colic** artery
  - **ileocolic artery** [termination of superior mesenteric, giving off the **appendicular** branch to the appendix]
- **Hindgut:** **Inferior mesenteric artery** [L3, aorta]
  - **left colic** artery
  - 2-3 **sigmoidal** branches
  - **superior rectal [haemorrhoidal]** artery

### THE PORTAL SYSTEM OF VEINS

The portal system drains blood from all the gastrointestinal tract [excluding the anus], the spleen and pancreas into the **liver sinusoids**. From there blood drains to the **inferior vena cava** via the three **hepatic veins**.

- **Portal vein:** Is formed behind and to the left of the head of the pancreas by the junction of the splenic and superior mesenteric veins. Receives the **coronary vein of the stomach** [left gastric] and occasionally the right gastric vein, which more often joins the coronary vein. Occasionally the coronary vein drains directly to the porto-splenic junction
- **Splenic vein:** Receives the **short gastric veins**, the **left gastroepiploic**, the **pancreatic veins** and the **inferior mesenteric vein**. It runs behind the pancreas.



- **Innervation of the GI Tract.**

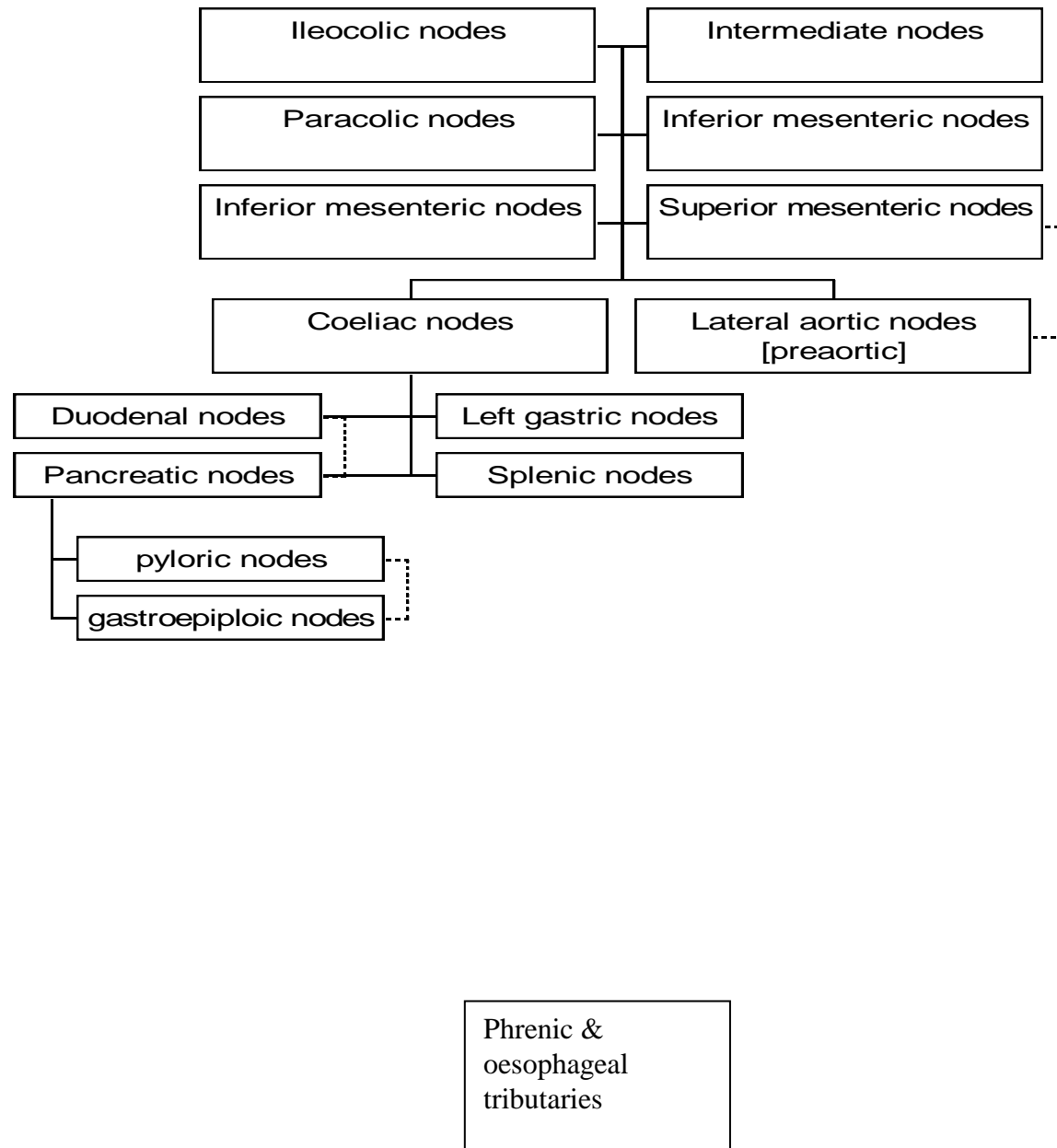
*Preganglionic sympathetic neurons [T5-L2] send axons through the ventral roots, spinal nerves, sympathetic chain and splanchnic nerves to the pre-vertebral ganglia. From the ganglia, new axons [postsynaptic] are sent to the gut wall. The cranial presynaptic parasympathetic neurons send their axons through the vagus to the enteric ganglia within the wall of the viscera [till splenic flexure]. The more distal parasympathetic innervation of the colon is provided from parasympathetic neurons of the S2-3 myelotomes that send their axons to the enteric ganglia.*

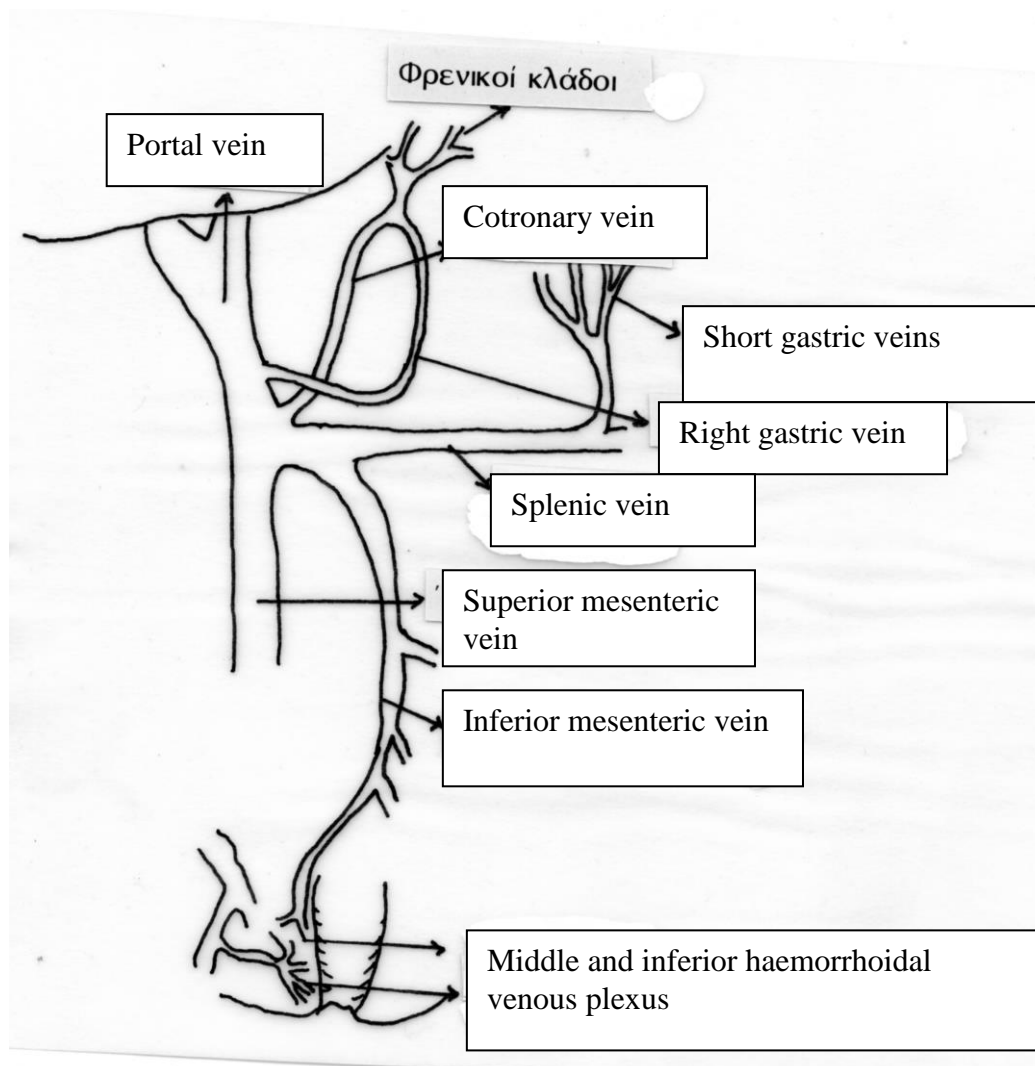
- **Superior mesenteric vein:** Starts as the **ileocolic vein** and receives [on its right side] the **right** and **midcolic veins**, the **pancreaticoduodenal** and the **right gastrepiploic vein**; on its left side it receives the **jejunal and ileal veins**. It runs in the root of the mesentery and behind the neck of the pancreas.
- **Inferior mesenteric vein;** Starts as the **superior rectal [haemorrhoidal]** vein, receives the **sigmoidal** and **left colic vein** and drains to the splenic artery.

## PORTOSYSTEMIC COMMUNICATIONS

1. **Oesophageal branch of the left gastric vein** and **oesophageal branches of the azygos vein** → oesophageal varices.
2. **Superior rectal vein** anastomosing with **inferior rectal** [tributary to the internal pudental → internal iliac] and **middle rectal vein** [external pudental → internal iliac vein] → profuse bleeding from haemorrhoids.
3. **Portal twigs of the liver** communicating with the **veins of the falciform ligament** and ligamentum teres → **umbilical/paraumbilical** area, where they communicate with the **epigastric veins** of the abdominal wall [→ **caput Medusae**]
4. **Twigs [portal] of veins in the mesocolon and mesentery** which communicate with **retroperitoneal veins** [renal, lumbar, phrenic]
5. **Portal branches of the liver** and systemic **veins of the diaphragm**, across the bare area at the posterior liver surface.

## LYMPHATIC DRAINAGE OF THE INTESTINE





- *Portal circulation*

## THE STOMACH

J-shaped, elongated in asthenic individuals, high and transverse in obese

- **Two surfaces:** anterior & posterior
- **Two edges:** greater and lesser curvature

- **Two orifices: cardia and pylorus**

## RELATIONS

- **Anteriorly:** abdominal wall, costal margin, left lobe of liver
- **Posteriorly:** lesser sac, crura of diaphragm, aorta, pancreas, kidney, suprarenal, spleen, splenic artery
- **Laterally:** spleen, diaphragm, costal margin, abdominal wall
- **Medially:** liver, aorta, lesser omentum, duodenum
- **Cephalad:** oesophagus, diaphragm, liver
- **Caudally:** great omentum, transverse colon, mesocolon

## DIVISIONS

- **Anatomic**
  - **CARDIA**, at the cardioesophageal junction
  - **FUNDUS**, lying cephalad to the cardia
  - **BODY [CORPUS]**, the capacious central part
  - **ANTRUM**, starting at the angular incisure on the lesser curvarure
  - **PYLORIC CANAL**
  - **PYLORUS**, the boundary with the duodenum [**vein of Mayo** on the anterior surface]
- **Functional gland areas**
  - **CARDIAC GLAND AREA:** small segment at the cardioesophageal junction with mucus secreting cells
  - **OXYNTIC GLAND AREA:** fundus and body, containing parietal [oxyntic] cells, chief [zymogen] and mucus [goblet] cells
  - **PYLORIC GLAND AREA:** distal third, containing G-cells [gastrin] and mucus cells

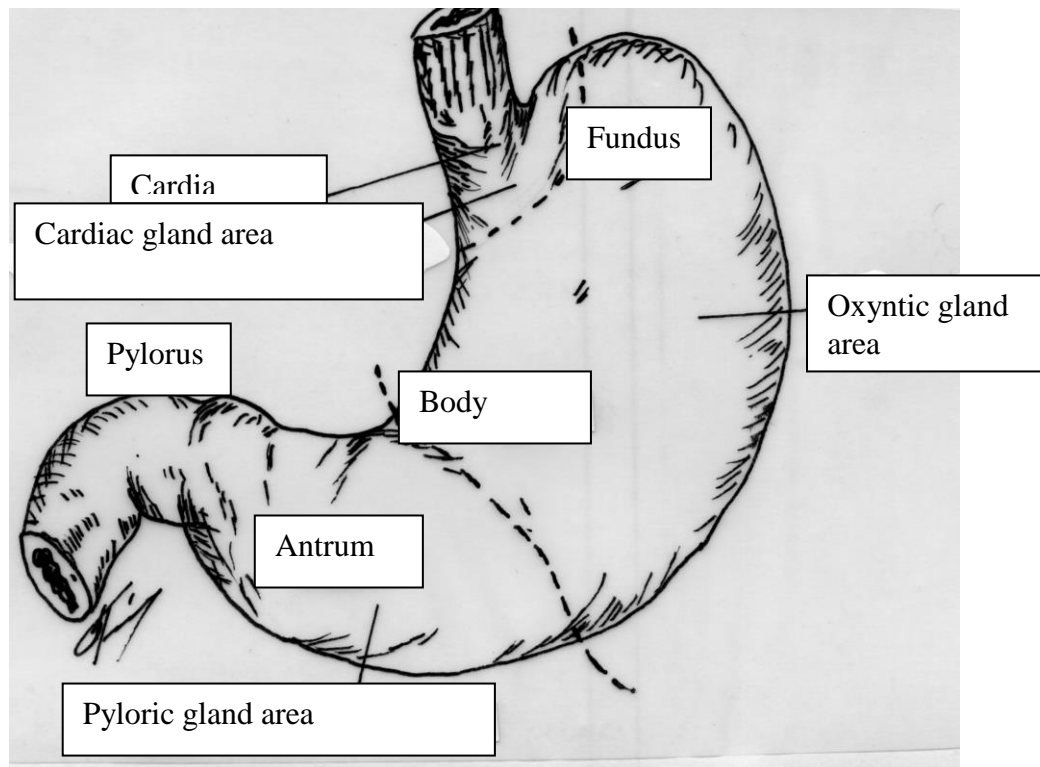
## LAYERS

- **Serosa**
- **Outer longitudinal muscle layer**
- **Inner circular muscle layer**
- **Intermediate oblique muscle layer** prominent at the lesser curveture
- **Submucosa [muscularis mucosa]**
- **Mucosa: Cylindric, columnar.** Bears crypt like glands projecting down to the muscularis mucosa.

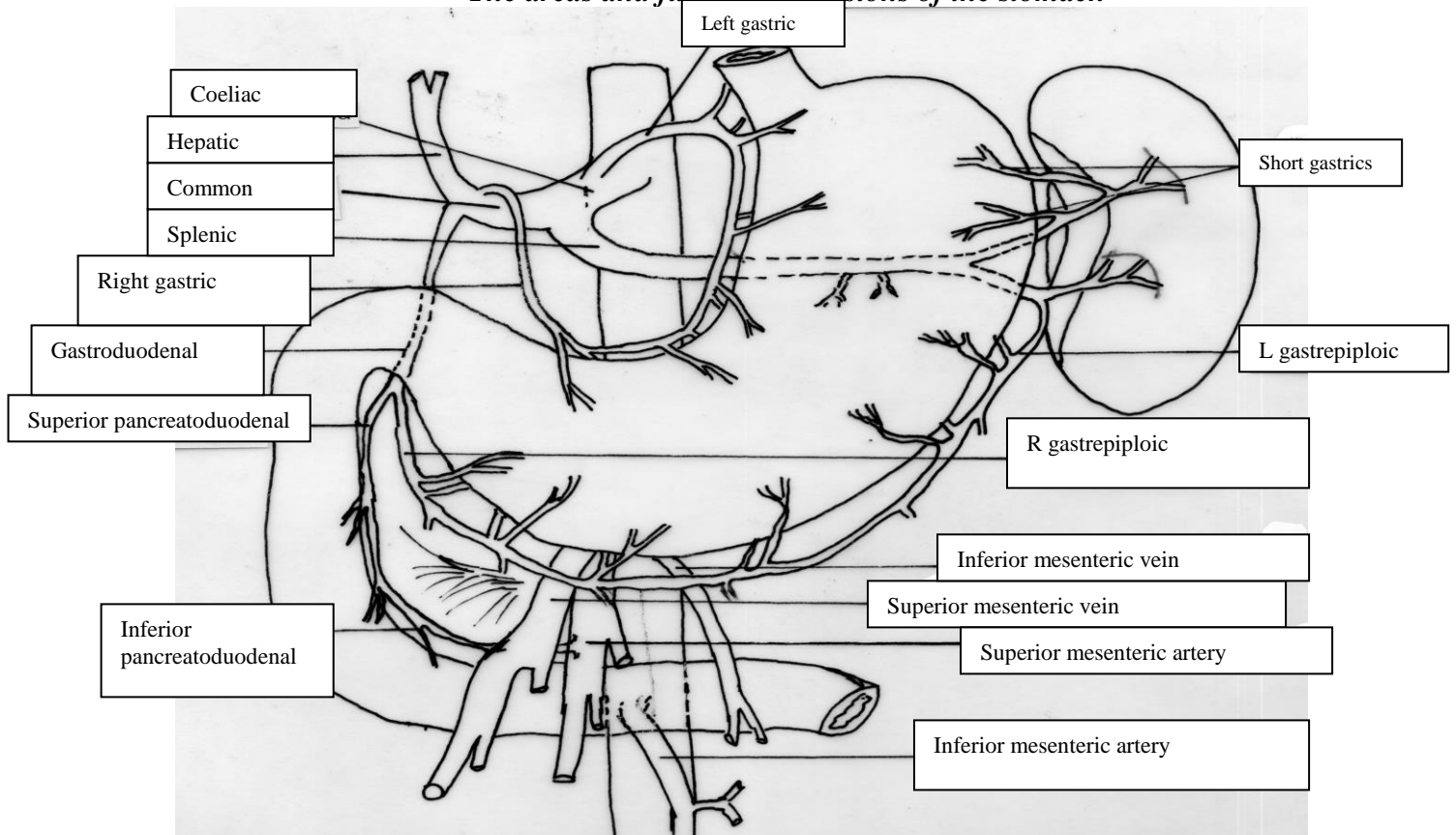
## SPHINCTERS

- **Pylorus**

Prominent circular muscle coating which behaves like a sphincter but allows little to-and-fro movement



- *The areas and functional divisions of the stomach*



- *Arteries of stomach & duodenum [frontal view]*



- **Cardia**

Is not a distinct sphincter, but retrograde flow of gastric juice is not allowed, due to:

1. acute angle of entry of the oesophagus into the stomach [**cardiac incisure**]
2. prominent **circular oesophageal muscle**
3. valve like action of the **mucosal folds**
4. special arrangement of the muscle fibers of the **fundus** of the stomach around the cardia
5. **right crus** of the diaphragm which acts as a pinch-hook
6. **positive intraabdominal pressure** that compresses the intra-abdominal part of the oesophagus
7. **phrenoesophageal membrane** which stabilises the oesophagus

## ARTERIAL SUPPLY

Very rich anastomotic network

- **Left gastric artery** [from coeliac axis] giving off the gastric and phreno-oesophageal branch
- **Right gastric artery** [from the hepatic branch of the coeliac axis]
- **Right gastro-epiploic artery** [from the gastroduodenal (hepatic)]
- **Left gastro-epiploic artery** [from the splenic artery]
- **Short gastric arteries** [from the splenic]
- **Posterior gastric artery** [from the splenic] present in 50% of individuals

## VENOUS DRAINAGE

- **Is portosystemic**, but most of it drains into the portal system
- The veins accompany the arteries [gastrepiploic, right gastric etc]
- The main vein is the **left gastric [coronary]** which joins the portal vein right after its junction with the splenic
- The **short gastric**, upper left gastric and cardiac veins drain into the azygos system

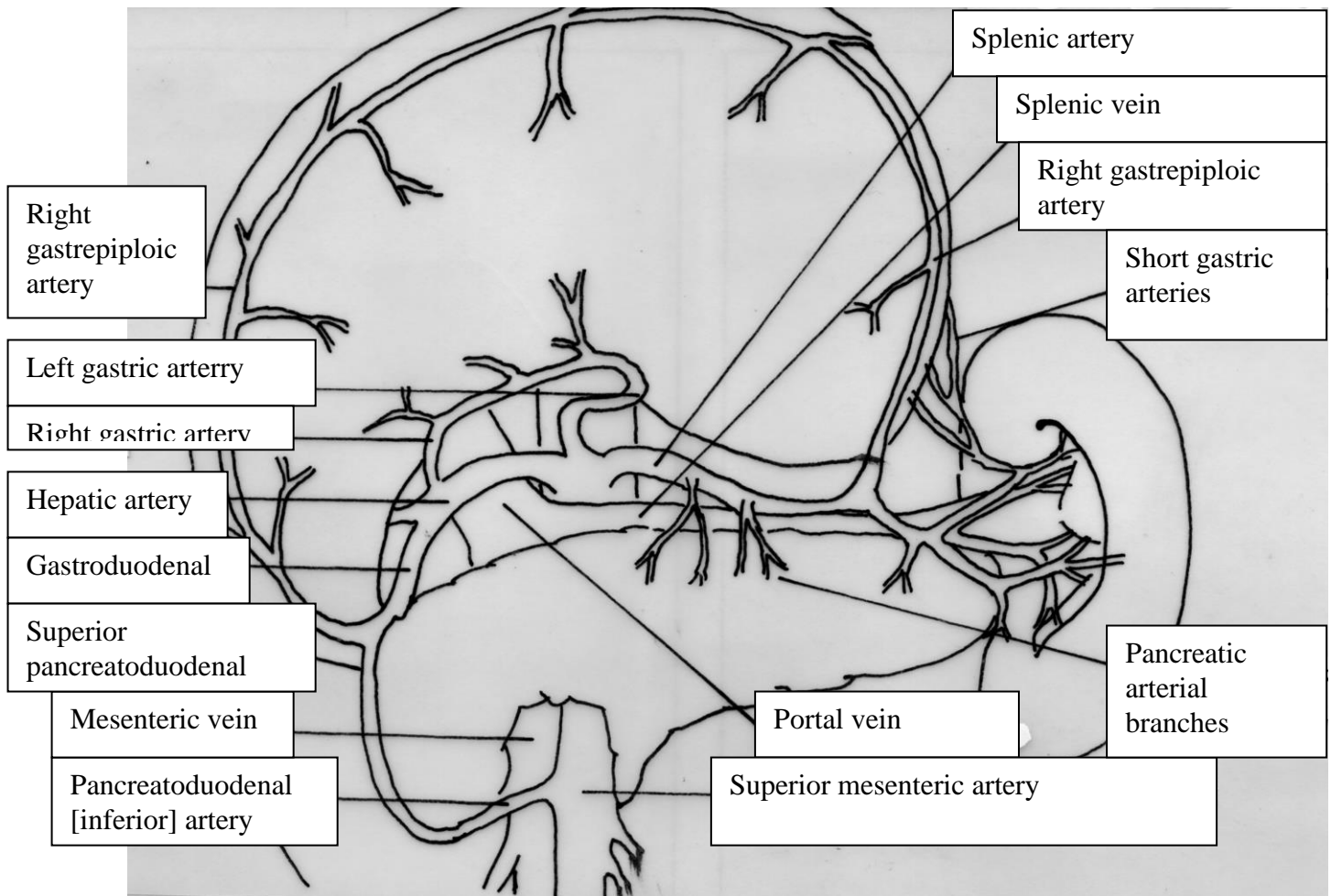
## LYMPHATIC DRAINAGE

- **AREA I:** [2/3rds of stomach, at the medial aspect, along the lesser curvature] drains to the left and right gastric nodes and from them to the aortic nodes.
- **AREA II:** [lower part of great curvature] gastrepiploic nodes, subpyloric nodes, suprapancreatic nodes, aortic nodes.
- **AREA III:** [fundus, upper greater curvature] splenic nodes, superior pancreatic nodes, aortic nodes.

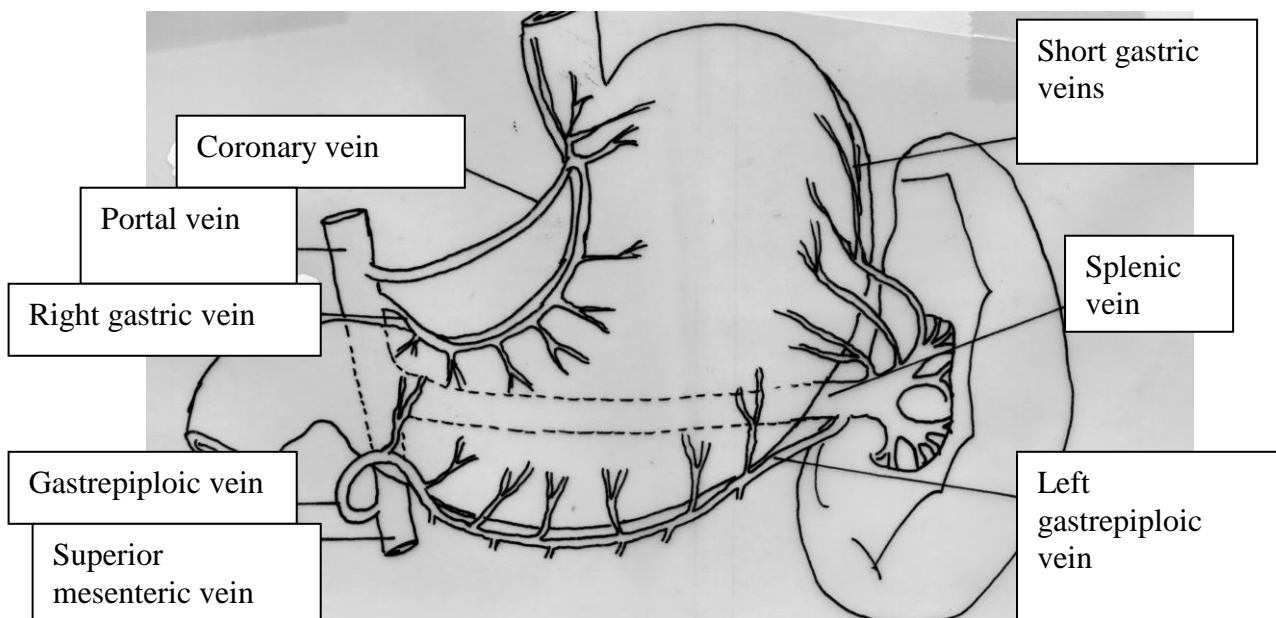
## VAGAL SUPPLY

The vagi enter the abdomen through the hiatus. They constitute the secretory and motor nerve supply to the stomach. With vagotomy the reflex [neurogenic] acid secretion is abolished but the stomach becomes atonic, so a drainage procedure is necessary, except in cases in which the Latarjet nerves, supplying the pylorus, are preserved.

- **Left, anterior vagus**
  - Lies close to anterior oesophageal wall
  - Gives off the **nerve of Grassi** to the fundus
  - Branch for the cardia



• *The gastric blood supply [posterior view with the stomach lifted]*



• *Venous drainage of the stomach*

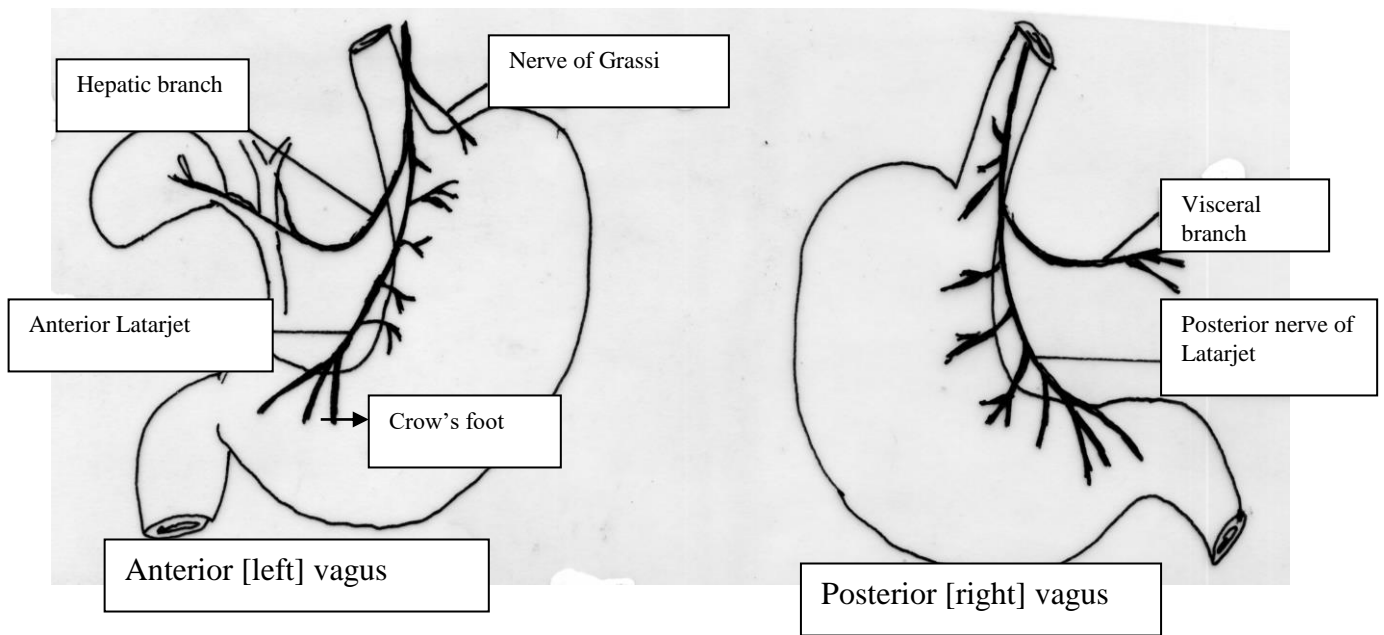
- **Anterior nerve of Latarjet [crow's foot]**
- **Right, posterior vagus**
  - Lies posteriorly and to some distance from the oesophagus, in front of the aorta
  - Usually bi- trifurcates above the cardiooesophageal junction
  - Cardiac branch
  - **Coeliac branch**, across the left gastric artery, to the **coeliac ganglion**. From there it distributes to the pancreas and the intestine as far as the mid-transverse colon
  - **Posterior nerve of Latarjet**

## DUODENUM

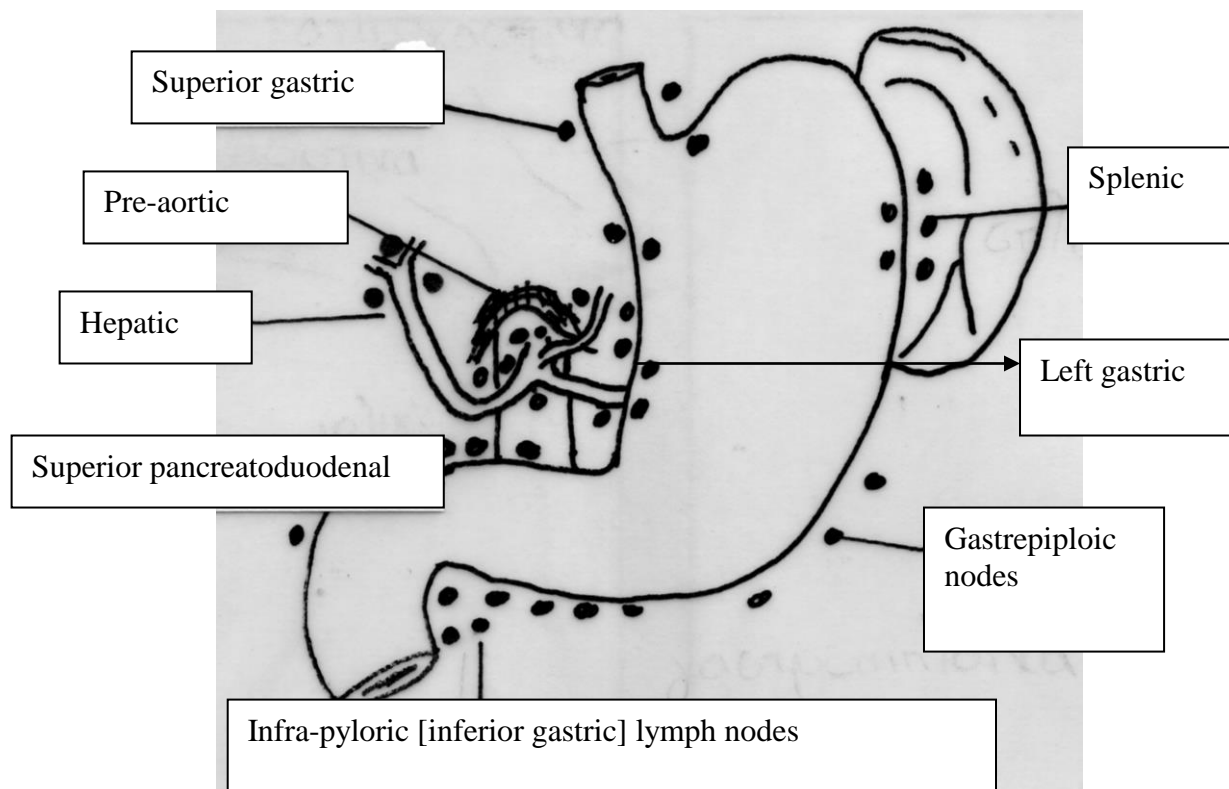
- 25cm long
- curves as a C around the head of the pancreas
- only its origin [duodenal cap, 2.5cm which looks like a flame on barium swallow] is completely covered with serosa

## DIVISIONS

- **FIRST PART [5cm, bulb or cap]**, radiologically looks like a **flame**.
  - overlapped by the liver and gallbladder [the commonest site for erosion from a gallstone]
  - crossed [posteriorly] by the gastroduodenal artery [this is why posterior ulcers may bleed massively, as they erode into the artery]
  - immediately posterior to it is the **hepatoduodenal ligament** [conveys portal vein and bile duct]
- **SECOND PART [7cm, descending]**
  - **Curves around the head of the pancreas**
  - Is crossed by the transverse colon [risk of injury during R hemicolectomy]
  - Lies over the right kidney, the ureter and the inferior vena cava
  - Posteromedially lie the common bile duct and the main pancreatic duct [**Wirsung**] which usually have a common opening in the **duodenal papilla [ampulla of Vater]**, guarded by the **sphincter of Oddi**
  - The subsidiary pancreatic **duct of Santorini** usually opens a little higher
- **THIRD PART [10cm, transverse]**
  - Retroperitoneal, runs to the left and crosses the IVC and the aorta at the L3 level
  - On its upper border is the head of the pancreas
  - Is crossed by the root of the mesentery and the superior mesenteric vessels
- **FOURTH PART [2.5cm, ascending]**
  - Ascends upward to the left to the duodeno-jejunal junction
  - The **ligament of Treitz**, a peritoneal fold, suspends it to the right crus of the diaphragm
  - Left to it lie the inferior mesenteric vessels
  - Posterior to it lies the left renal vein



- The vagal supply of stomach*



- Gastric and duodenal lymph nodes*

## LAYERS

- **two muscle layers** [inner longitudinal, outer circular]
- **submucosa**
- **cylindric mucosa** forming crypts extending to the submucosa [**Brunner's glands**]

## BLOOD SUPPLY

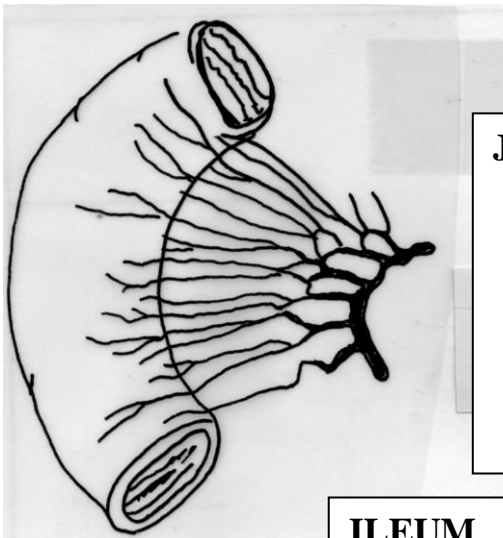
- **superior pancreaticoduodenal** artery [branch of the gastroduodenal]
- **inferior pancreaticoduodenal** artery [first branch of the superior mesenteric artery]

## VENOUS DRAINAGE

**Anterior and posterior pancreaticoduodenal venous arcades** [SMV and portal]

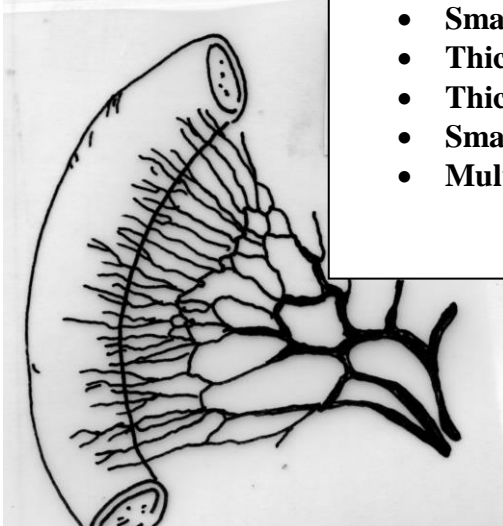
## SMALL INTESTINE

- Average length, from the **ligament of Treitz** to the **ileocecal valve**, 6m
- The upper half is the **jejunum**, the lower half is the **ileum**
- Is attached to the posterior abdominal wall by the 15cm long **mesentery** which starts at the duodeno-jejunal junction [**L2 level**] and passes to the right sacroiliac joint. It contains the superior mesenteric artery and vein, lymph nodes and autonomic fibers
- **BRANCHES OF THE SUPERIOR MESENTERIC ARTERY**
  1. **Inferior pancreaticoduodenal**
  2. **Middle colic** [superiorly]
  3. 10-15 **small intestinal arteries** that pass to the left
  4. **Ileocolic artery** to the right which gives off:
    - a. **Right colic artery**
    - b. **Ileal artery** for the terminal ileum
- **DIFFERENCES BETWEEN JEJUNUM AND ILEUM:**
  - Thicker wall in the jejunum
  - Thicker, circular folds in the jejunal mucosa [**plicae circularis**]
  - The jejunum usually occupies the umbilical region while the ileum the hypogastrium and pelvis
  - The mesenteric fat folds that cover the mesenteric border of the bowel are thicker the more distal the bowel [**encroaching fat** of the ileum]
  - Greater diameter proximally than distally
  - The **mesenteric vessel arcade** consists of one or two arcades in the jejunum with long and relatively infrequent branches leading to the bowel, while the mesenteric vessels in the ileum form multiple arcades with numerous and shorter terminal branches.
  - The lymphoid tissue of the submucosa becomes more prominent in the ileum [**Payer's patches**]



### JEJUNUM

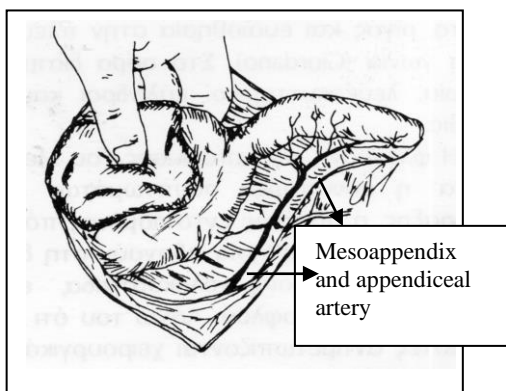
- Greater diameter
- Thinner wall
- Thin mesentery
- A single vascular arcade
- Long terminal branches



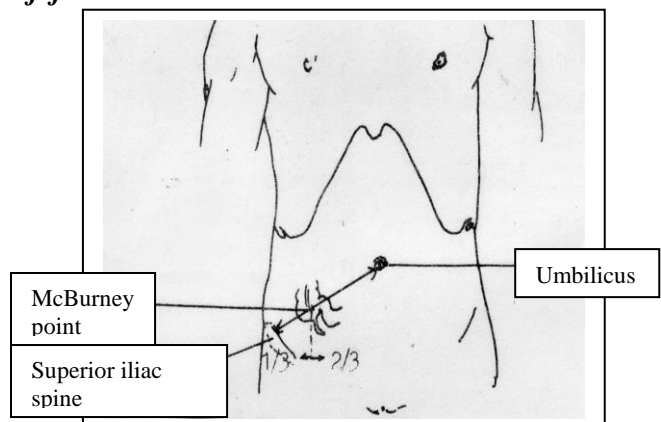
### ILEUM

- Small diameter
- Thicker wall
- Thick mesentery with pronounced fat content
- Small and multiple terminal vessels
- Multiple vascular arches

### • Differences between jejunum and ileum



*e vermiform appendix  
and the Mc Burney point*



### • Th

- **MICROSCOPIC ANATOMY**
- **Serosa**
- **Muscularis** [inner circular, outer longitudinal layers of smooth muscle]
- **Submucosa** [strong, fibroelastic]
- **Mucosa:** columnar epithelium with mucous producing goblet cells, forming **villi** and **microvilli**, as well as the crypts of **Lieberkuhn**, increasing thus the absorptive surface by 24 times

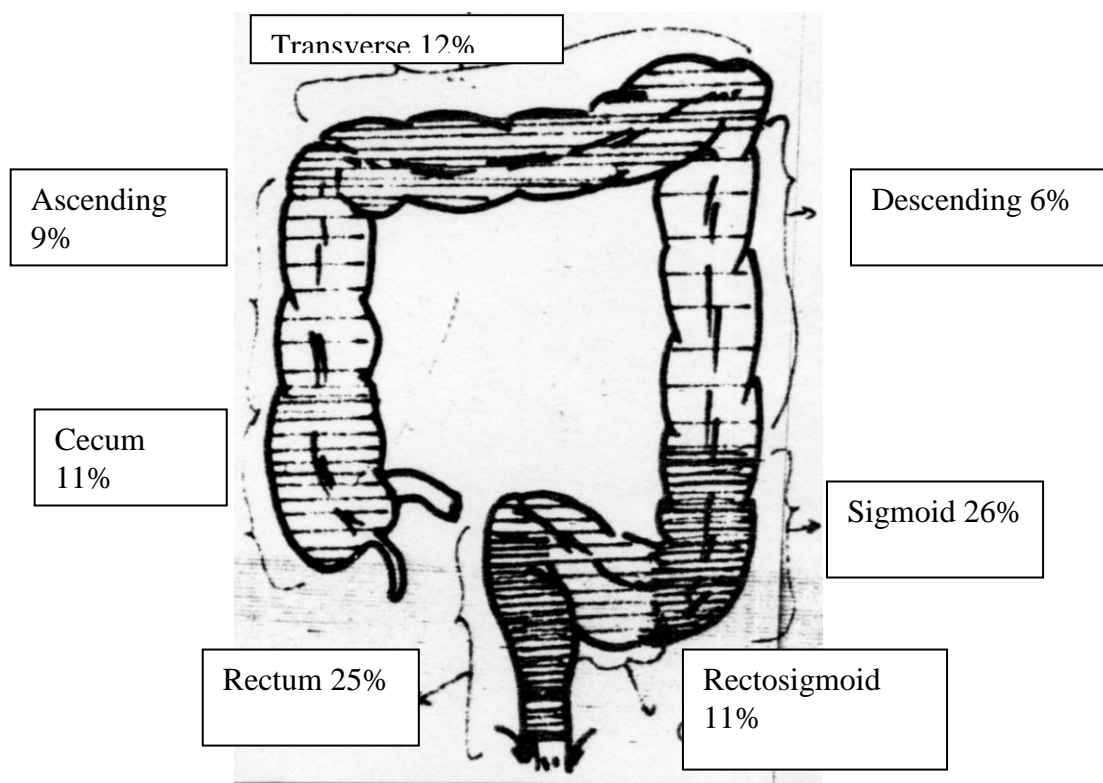
## **VERMIFORM APPENDIX**

- Arises from the posteromedial aspect of the cecum, where the **taeniae coli converge**, 2.5 cm below the ileocecal fold
- Average length is 7cm
- Its position is variable: **in 70% is retrocecal**, in 20% pelvic and in 10% retroperitoneal
- The **ileocecal fold** has two parts: one [vascular] passing above the ileum towards the cecum and an inferior avascular [**bloodless field of Treves**] which connects the ileum to the base of the cecum and the appendiceal base
- The **mesoappendix** is a triangular fold descending behind the ileum; on its medial border is the appendiceal artery while on its lateral is the appendix
- The **appendiceal artery** [branch of the ileocolic] is the single blood supply to the appendix and in cases of infection it may thrombose [resulting in gangrene and perforation]
- The lumen of the appendix is quite wide in infants and narrows with age, to become obliterated in the elderly [this is the reason why **appendicitis is uncommon in the two extremes of age**]

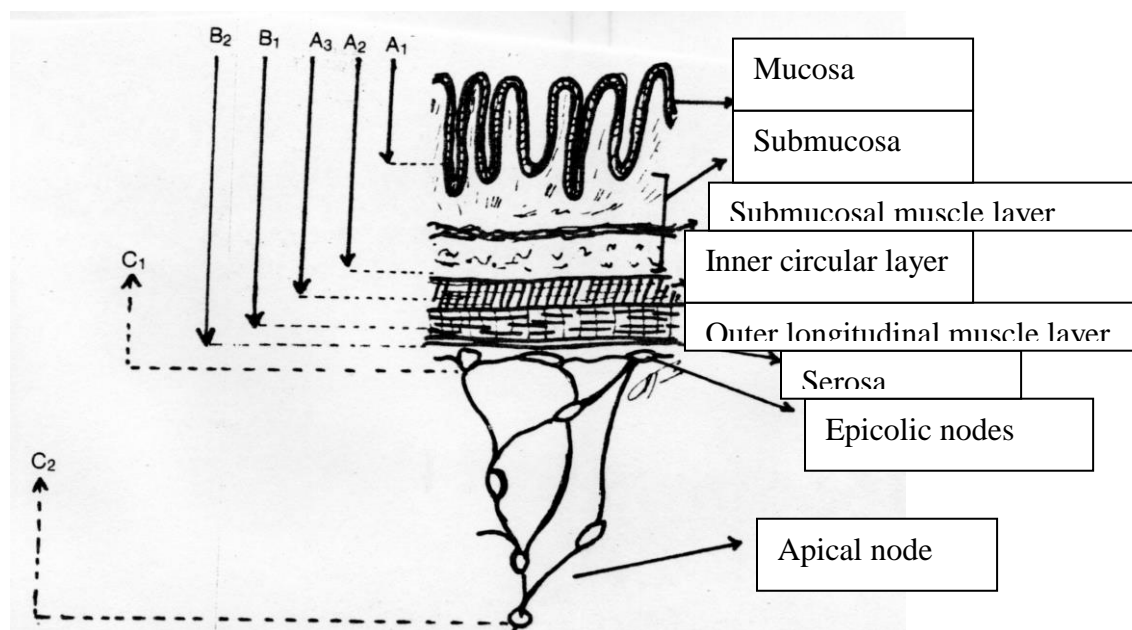
## **THE LARGE INTESTINE**

### **SUBDIVISIONS**

- Average length: 150cm
- **Right colon**
  - **Cecum** [12cm]
  - **Ascending colon** [12-20cm] reaching the **hepatic flexure** and forming on its side the **right paracolic gutter**
  - Proximal 2/3rds of **transverse colon** [30cm]
- **Left colon**
- **Distal transverse colon** [15cm] to the **splenic flexure**



- *Divisions of colon and prevalence of cancer*



- *Structure of large bowel [and Astler-Coller staging of cancer]*



- **Descending colon** [22-30cm] and forming on its lateral side the **left paracolic gutter**
- **Sigmoid colon** [35cm, range 12-75cm]
- **Rectum** [12cm]
- **Anal canal** [4cm]

## CHARACTERISTICS

- Transverse colon and sigmoid are completely peritonealised and are attached to the **mesocolon** and **mesosigmoid**. The cecum is also usually completely intraperitoneal. The ascending and descending colon are not completely peritonealised [only anteriorly] and thus have no mesocolon. The rectum bears peritoneum on its anterior and lateral surfaces on its upper third, only anteriorly on its middle third and is extraperitoneal in its lower third
- **Appendices epiploicae**: Fat filled peritoneal tags attached to the surface of the colon [absent in cecum and rectum]
- **Haustrations**: sacculations of the wall [not in lower 2/3rds of rectum] which look as incomplete septa on X-rays [while the mucosal folds of small bowel traverse its diameter]
- **Taeniae coli**: bands representing concentrations of the longitudinal muscle coat [they start fusing on the sigmoid and are not visible in the rectum]

## HISTOLOGIC ANATOMY

- **Mucosa**: cylindric with lots of mucous secreting goblet cells
- **Submucosa**
- **Muscularis**: inner circular, outer longitudinal forming the taeniae coli
- **Serosa**
- **Nerve plexus of Meissner** in the submucosa and nerve **plexus of Auerbach** between the circular and longitudinal muscle coat

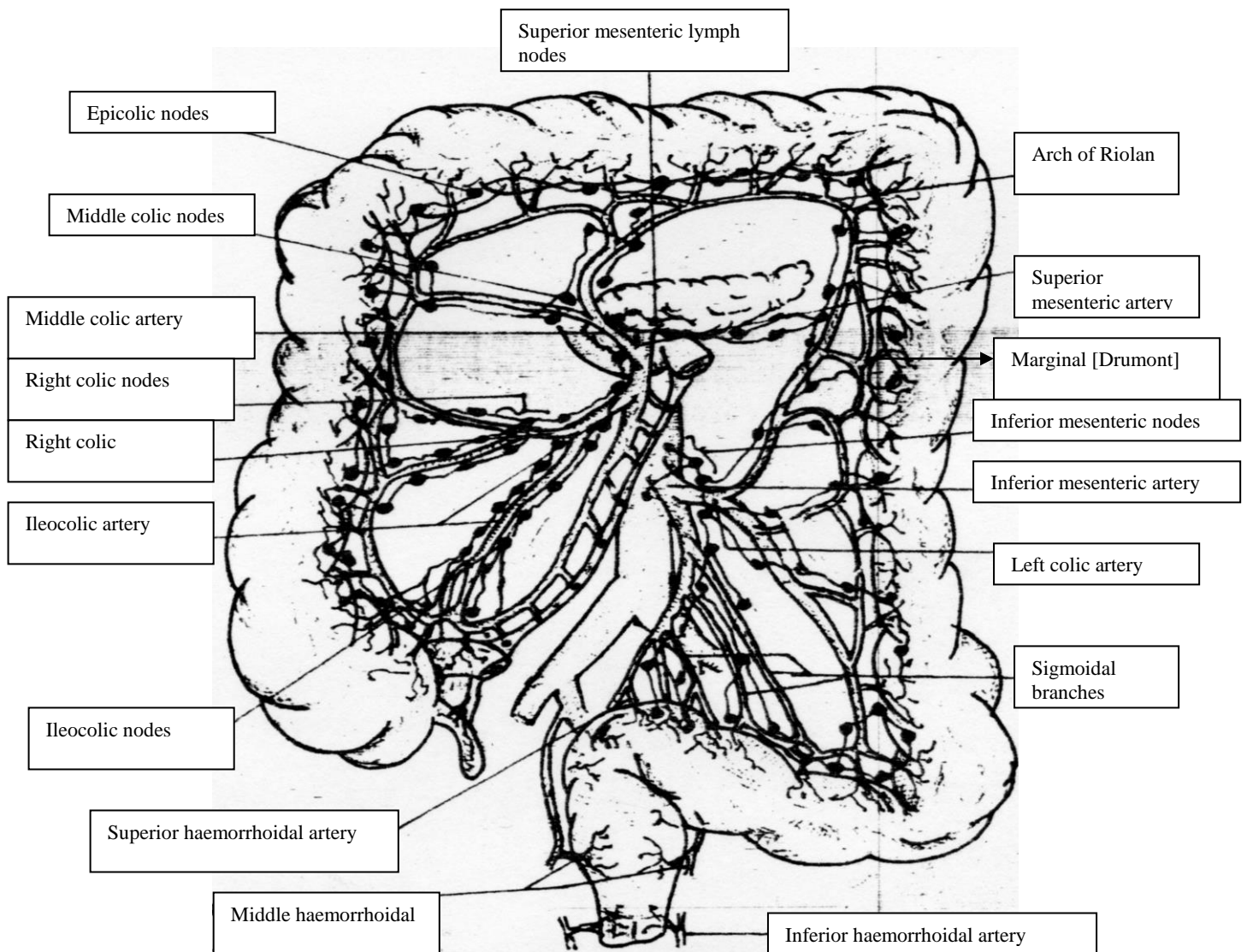
## BLOOD SUPPLY

- From **superior mesenteric artery** [L<sub>1</sub> level, originating from the aorta]:
  - **Ileocolic artery** [gives off the **appendiceal**] supplies the terminal ileum and cecum
  - **Right colic artery** [may come off the SMA or the ileocolic], supplying the ascending colon and the hepatic flexure
  - **Middle colic artery** [left and right branches] supplying the transverse colon.
- **Inferior mesenteric artery** [L<sub>3</sub> level, originating from the aorta]:
  - **Left colic artery**, supplying the splenic flexure and the descending colon. Communicates with the left branch of the middle colic via the **marginal artery of Drummond** forming the **arch of Riordan**
  - **Rectosigmoid branches** [2-3]
  - **Superior rectal [haemorrhoidal] artery**
- **Middle rectal artery**, a branch of the internal iliac or the external pudental artery
- **Inferior rectal artery**, branch of the internal pudental

## VENOUS DRAINAGE

- **Portal:**

- The ileocolic, right and middle colic veins join the superior mesenteric vein.



- *Arteries and lymph nodes of the large bowel [the veins follow the arteries]*

- On the left side the inferior mesenteric vein is formed which joins the superior mesenteric above and medial to the ligament of Treitz
- The superior rectal vein
- **Systemic:**
  - Inferior and middle rectal veins drain into the internal iliac veins. The rich anastomotic network with the superior rectal forms one of the sites of portosystemic communications

## LYMPHATIC DRAINAGE

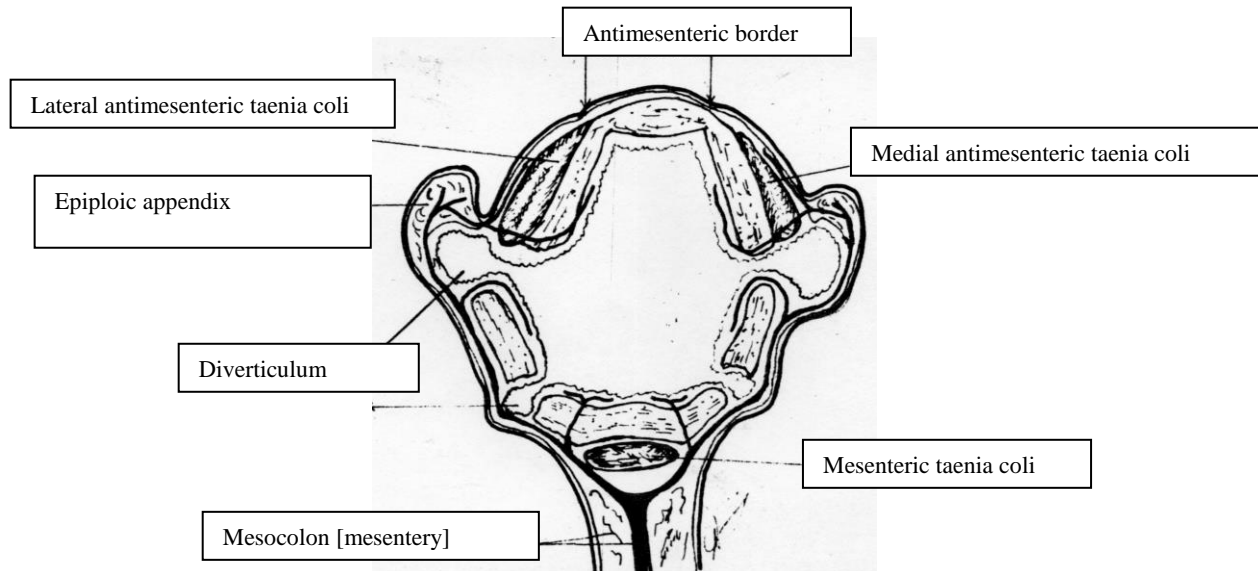
- Follows the arterial supply
- Paracolic [epicolic] nodes
  - intermediate nodes [ileocolic, left colic etc]
  - superior mesenteric nodes → coeliac and preaortic nodes
  - inferior mesenteric nodes → preaortic nodes & proximal superior mesenteric nodes
- Lymph channels above the pectinate line → internal iliac nodes → preaortic nodes
- Below pectinate line [anus] → superficial inguinal nodes

## INNERVATION [AUTONOMIC SYSTEM]

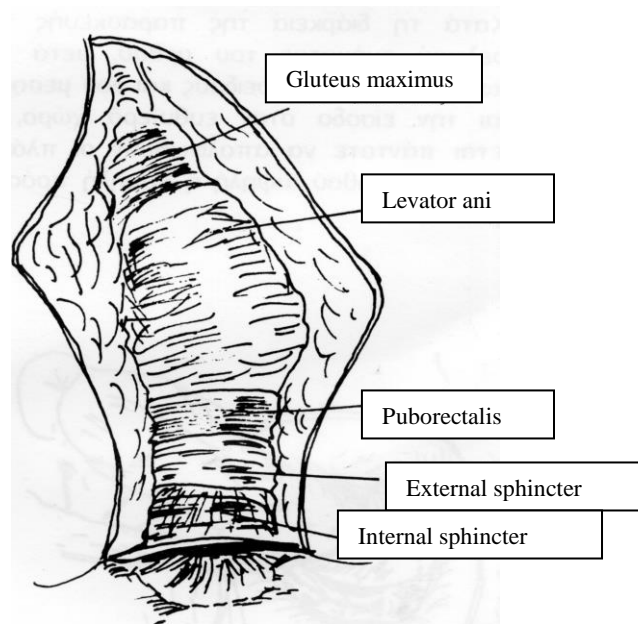
- **PARASYMPATHETIC**
  - **Vagus**, [via the coeliac plexus] till the splenic flexure
  - **Nervi erigentes** [pelvic splanchnic nerves] from S<sub>2-4</sub> of the spinal cord [via the iliac/pelvic plexus] supply the rest of the colon
- **SYMPATHETIC**
  - **Greater splanchnic nerves** [T<sub>10-12</sub>] via the coeliac plexus supply the right colon
  - **Lesser splanchnic nerves** [L<sub>1-3</sub>] which accompany the IMA supply left colon

## THE RECTUM

- 12cm, commences at the origin of S<sub>3</sub> [where the mesosigmoid ends] and ends at the tip of the prostate and coccyx, where it pierces the pelvic floor formed by the levator ani muscle group
- It is curved [to fit the sacral hollow] and the part above the pelvic floor is the widest [**ampulla**]
- Has three lateral inflexions called **valves of Houston**
- **RELATIONS**
- **Anteriorly:**
  - Intraperitoneal part: the peritoneum of the pelvic floor reflects upwards to the rectum, forming the **Duglass pouch** [rectouterine or rectovesical] which contains coils of small intestine
  - Extraperitoneal: the **Denonvilliers fascia** separates it from the bladder, seminal vesicles and prostate or the uterus and vagina
- **Posteriorly:**
  - Sacrum and coccyx, mid-sacral artery, extraperitoneal connective tissue containing vessels and lymphatics, the lower sacral nerves S<sub>2-4</sub>
- **Laterally:**
  - **Levator ani** [puborectalis], pubococcygeous, rectovesicalis muscle



- *Colonic diverticulum*



- *Posterior view of anus & rectum*

- **Lateral ligament**, conveying the middle rectal [haemorrhoidal] artery, a branch of the external pudental artery

## THE ANUS & ANAL CANAL

The **anal canal** is 4cm long and is directed downwards and backwards to reach the anal orifice [anus].

Its upper end is the **anorectal ring** [the point where the deep external sphincter blends with the levator ani].

The **mucocutaneous junction** is in the mid-anal canal and represents the junction between endoderm and exoderm. Thus, the upper half of the anal canal is lined by **cylindrical epithelium** while the lower half by **squamus**. There is a transitional zone with single stratified epithelium, called the **pectinate line**. Above it arise vertical mucosal columns [**columns of Morgagni**] which bear the **valves of Ball** [cap-like folds] at their distal end.

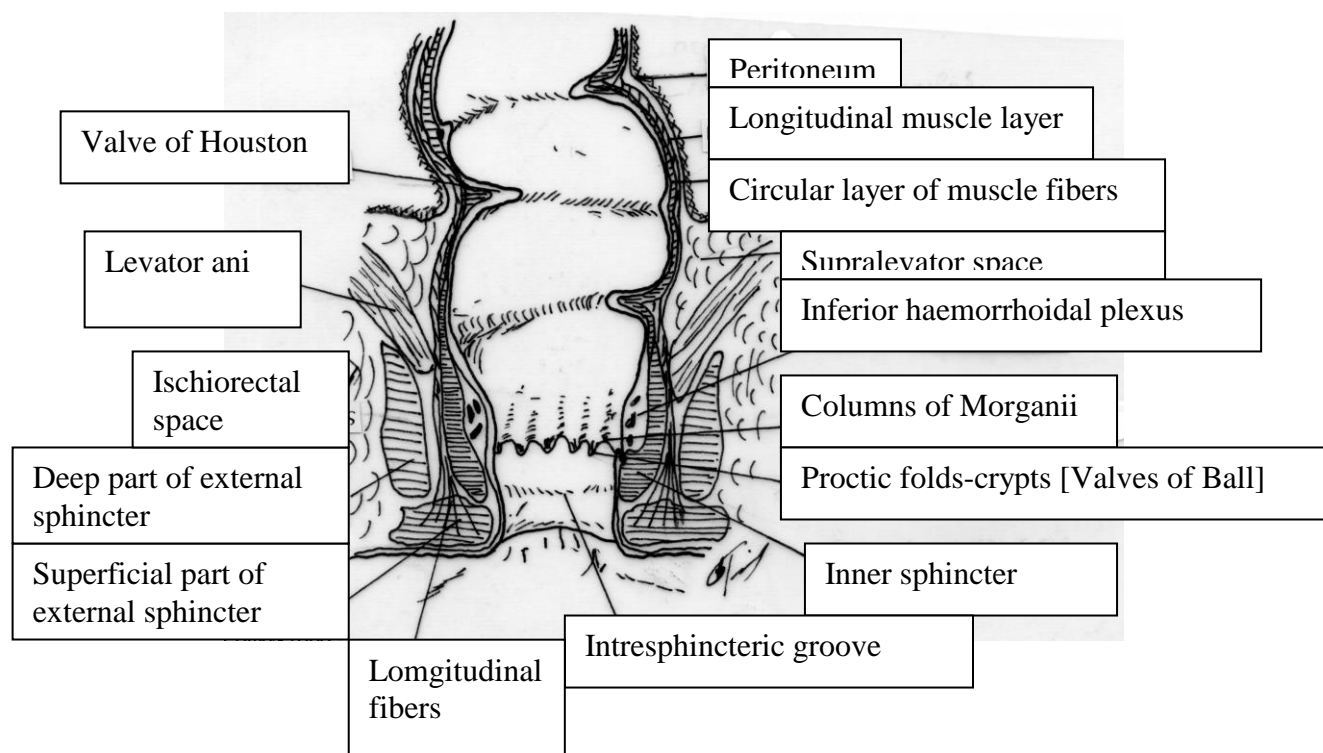
- **BLOOD SUPPLY:**
- **Superior haemorrhoidal**, branch of the **left colic**. It supplies the upper half of the anal canal.
- **Middle haemorrhoidal**, branch of the **internal pudental** [and the internal iliac]
- **Inferior haemorrhoidal**, branch of the **external pudental**
- **LYMPHATICS**

Above the mucocutaneous junction drain along the superior rectal vessels to the **lumbar and pre-aortic nodes**. Below it, they drain to the **inguinal nodes**.

- **NERVE SUPPLY**
- **Upper half:** autonomic fibers from the **hypogastric plexus**
- **Lower half:** somatic fibers from the **pudental and inferior haemorrhoidal nerve** [S2-4]

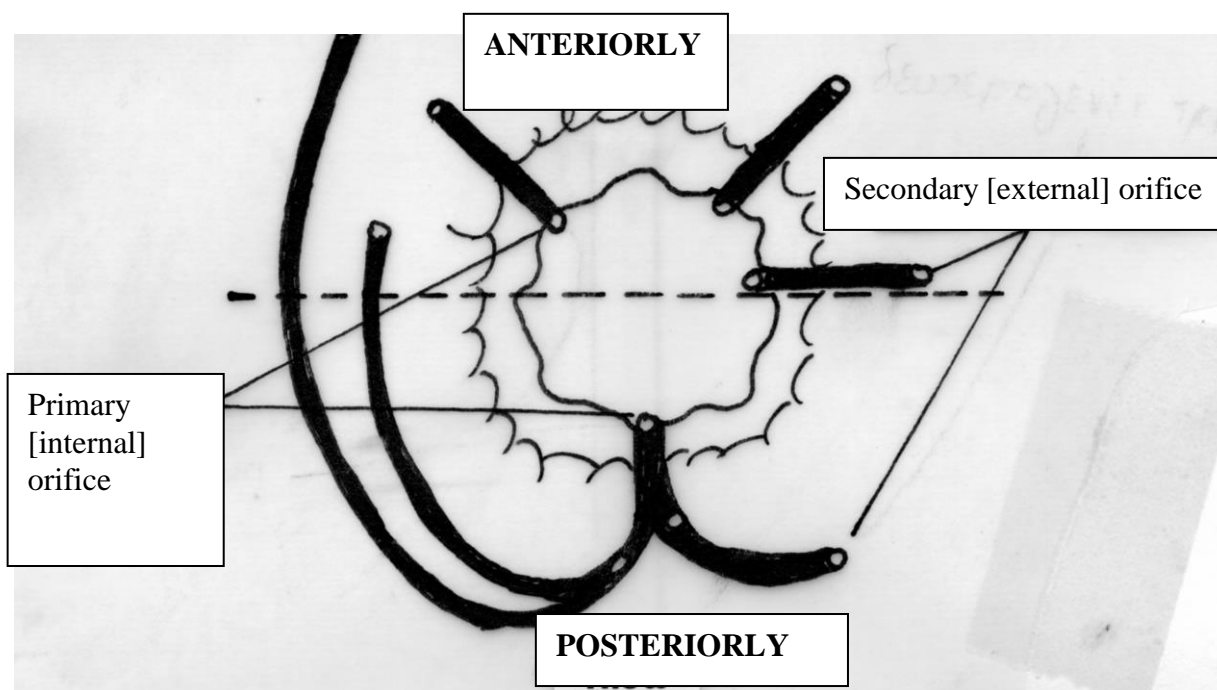
## THE ANAL SPHINCTER

- **INTERNAL ANAL SPHINCTER**
- It consists of involuntary muscle, from the **circular muscle layer of the rectum**.
- Is innervated by autonomic nerves, parasympathetic from the **pelvic splanchnic nerves**, sympathetic from the **superior hypogastric plexus** and the **sacral splanchnic nerves** which become intermingled with the **inferior hypogastric plexus**, located on the wall of the rectum. From there, fibers are conveyed to the rectum and sphincter.
- **EXTERNAL SPHINCTER:** voluntary muscle
- **Deep part:** surrounds the internal sphincter and fuses with levator ani
- **Superficial part:** extends downwards and curves medially
- **Subcutaneous part:** it is a fan-like expansion of the longitudinal fibers of the wall
- **BLOOD SUPPLY:** from the inferior rectal artery [pudental artery]
- **NERVE SUPPLY:** from the inferior rectal nerve [branch of the pudental nerve, S2-4 roots]
- **RELATIONS**
- **Posteriorly: anococcygeal body** [fibrous tissue between the anal canal and coccyx]
- **Anteriorly; perineal body** [fibrous tissue separating it from the urethral bulb]
- **Laterally: ischiorectal fossa**, containing fat



• **Anatomy of anus**

*[The mucocutaneous junction is formed by the columns of Morgagni and the valves of Ball]*



• **Salmon-Goodsall law [relation of orifices of perianal fistulae]**

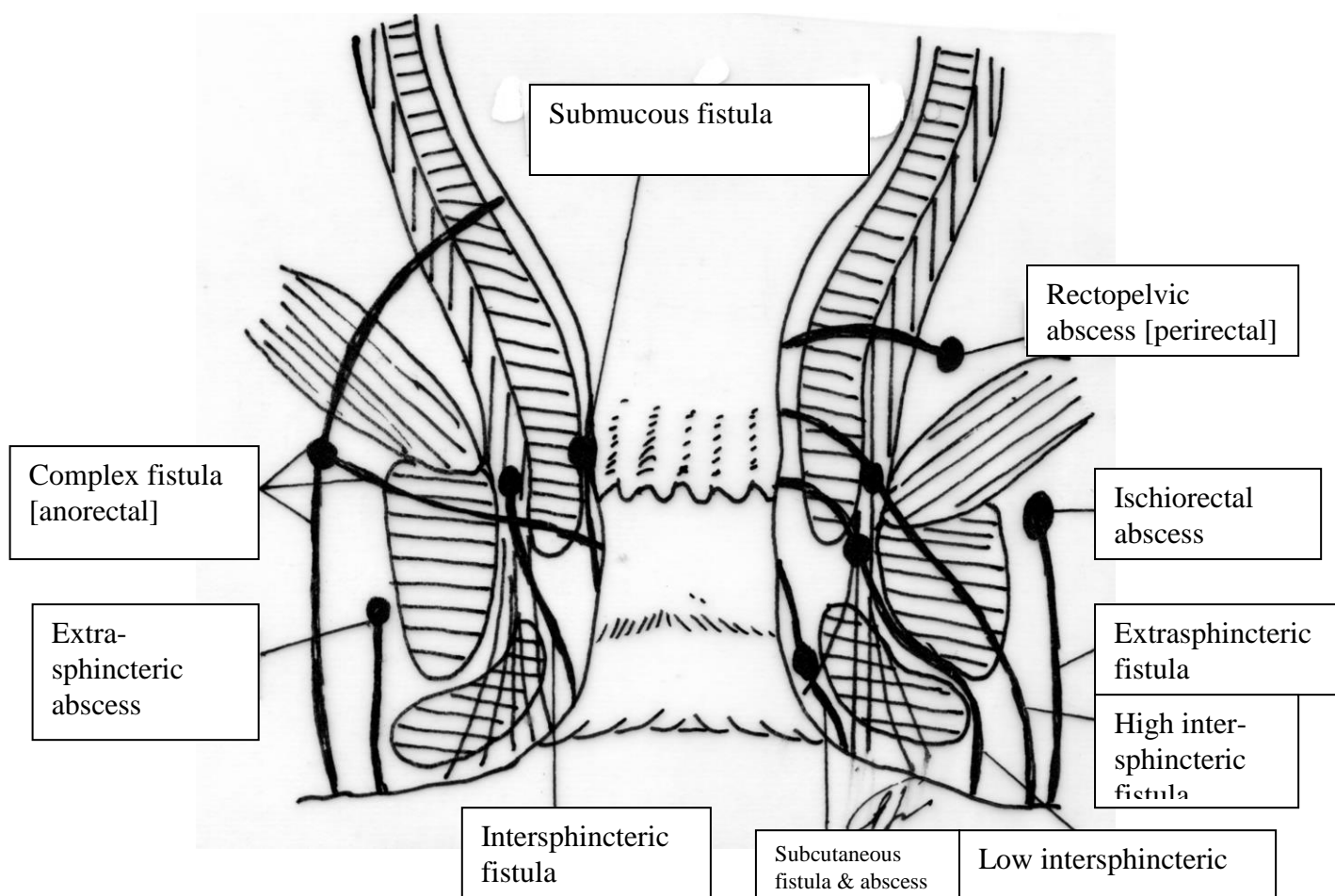
## HAEMORRHOIDS

Are **varicosities** of the **superior/middle rectal [haemorrhoidal] vein**, draining into the portal system. Because they are asymmetrical, the location of piles is at 3, 7 and 11 o'clock [patient on lithotomy position]

Varicosities of the **inferior rectal vein** form **external piles**, in the perianal skin

Each pile contains:

- varicose venous plexus
- terminal branch of the artery
- submucosa
- mucosa of the anal canal



• *Types of perianal fistulae and abscesses*

## PERIANAL ABSCESS

1. **Submucous:** localised beneath the anal mucosa

2. **Subcutaneous:** localised beneath the perianal skin
3. **Ischiorectal:** within the ischiorectal fossa
4. **Perirectal:** above the anal ring [levator ani]

### **PERIANAL FISTULAE**

They result from rupture of a perianal abscess. They usually have **two orifices**, an internal in the mucosa and an external in the perianal skin.

**Salmon-Goodsal Law:** By dividing the anus in superior and posterior halves by a transverse line, superior anal fistula have their internal orifice in a direct short line joining the external orifice to the pectinate line [as a ray line]. Posterior fistulae have their internal orifice in the midline, despite the site of the external orifice.

- a. **Submucous:** Confined within the anal mucosa
- b. **Subcutaneous**
- c. **Intersphincteric:** Passing through the lower part of the external sphincter [**low level**] or through the deep sphincter [**high level**]
- d. **Anorectal:** Passing from the pelvic-rectal space. They may or may not have an opening in the anus.

### **FISSURE IN ANO**

It is a tear in the anal mucosa, usually located in the posterior midline, due to the insertion of the superficial external sphincter to the coccyx, a relatively unsupported position, where it is easily torn by faeces.